REMARKS

Claims 1-37 are currently pending in this application, but have been rejected. Applicant respectfully requests reconsideration in light of the following remarks.

Claims 1-3, 5-8, 11-13 and 19 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Tasumi, U.S. Patent No. 5,818,322 (Tasumi) in view of Kozlowski et al., U.S. Patent No. 6,587,142 (Kozlowski). This rejection is respectfully traversed.

Claim 1 recites a "pixel cell for an image sensor" comprising, *inter alia*, "a photodiode for generating charge in response to light and for amplifying the generated charge, the photodiode being over a surface of a substrate and comprising a plurality of layers, wherein at least a first layer has a first band gap and at least a second layer has a second band gap" and "a gate adjacent to the photodiode for transferring the amplified charge from the photodiode." Tasumi, even when considered in combination with Kowalski, fails to teach or suggest all limitations of claim 1. Additionally, one of ordinary skill in the art would not have been motivated to combine the teachings of Tasumi and Kowalski as suggested by the Examiner.

Tasumi relates to a photosensitive element for optical communication in an OEIC (optoelectronic integrated circuit) structure. Tasumi at col. 1, lines 6-8. According to Tasumi, a photosensing portion 2 is buried and an optical fiber is fixed at the same height as the photosensing portion to introduce light in parallel along the surface. Tasumi teaches that this allows the step on the substrate surface to be eliminated thereby allowing the driver 3 to be formed on the same chip as the photosensing portion 2. Tasumi at col. 4, lines 1-10. Accordingly, Tasumi is silent about the driver transferring amplified charge from a photodiode. In fact, Tasumi teaches that the driver is a semiconductor device such as a pre-amplifier and identification circuit. Tasumi at col. 5, lines 43-45.

In contrast, Kozlowski relates to low noise MOS based imager having minimal analog components in each pixel. Kozlowski at col. 1, lines 12-15. Kozlowski teaches a low noise active-pixel sensor having a photodiode. According to Kozlowski, the photodiode connects to a gate of a source follower driver MOSFET, a source of a reset MOSFET and one side of a coupling capacitor. Kozlowski at col. 7, lines 4-11; FIG. 2. While Kozlowski show these connections as electrical connections, Kozlowski does not teach or suggest that the photodiode is adjacent to any MOSFET gate for transferring amplified charge from the photodiode. Kozlowski's source follower MOSFET does not transfer charge, but is an amplifier for charge to voltage conversion. As noted by Kozlowski, the source follower MOSFET transfers a voltage. Kozlowski at col. 8, lines 15-20. Thus, even when considered in combination, Tasumi and Kozlowski fail to teach or suggest all limitations of independent claim 1.

Further, one of ordinary skill in the art would not have been motivated to combine the teachings of Tasumi and Kozlowski as suggested by the Examiner. The Examiner's position is that the driver MOSFET of Kozlowski is equivalent to the driver taught by Tasumi. The Examiner reasons that because Tasumi teaches a driver adjacent to a photosensing portion for optical communication and Kozlowski teaches a driver MOSFET having a gate, it would be obvious to take Kozlowski's MOSFET and put it in Tasumi's structure in place of Tasumi's driver to achieve the claimed invention. Applicant respectfully submits, however, that no such motivation exists. Tasumi relates to a structure providing optical communication, whereas Kozlowski relates to an imager. There is no reason to consider Tasumi's driver, which can be contained on a different chip than the photosensing portion, is replaceable by a source follower MOSFET. Even if, Tasumi's driver could simply be replaced with a source follower MOSFET, as noted above, a source follower MOSFET is for charge to voltage conversion and amplification, not "transferring the amplified charge from the photodiode," as recited by claim 1. Moreover, Tasumi does not disclose the functions of its driver, much less that the driver is able to transfer charge

from a photodiode. For at least these reasons, withdrawal of this rejection is respectfully requested.

Claim 4 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Tasumi in view of Kozlowski, and in further view of Sugawa et al., U.S. Patent No. 6,127,692 (Sugawa). This rejection is respectfully traversed.

As discussed above, Tasumi, even when considered with Kozlowski, fails to teach or suggest all limitations of independent claim 1. Sugawa is cited for teaching that multiplication layers are configured to promote ionization by a first carrier type and suppress ionization by a second carrier type and does not supplement the deficiencies of Tasumi and Kozlowski. For at least these reasons, withdrawal of this rejection is respectfully requested.

Claim 9 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Tasumi in view of Kozlowski, and in further view of Brunner et al., U.S. Patent No. 6,403,975 (Brunner). This rejection is respectfully traversed.

As discussed above, Tasumi, even when considered with Kozlowski, fails to teach or suggest all limitations of independent claim 1. Brunner is cited for its teachings regarding the composition of layers in an active region of a photodetector, LED, optical modulator or waveguide and does not supplement the deficiencies of Tasumi and Kozlowski. For at least these reasons, withdrawal of this rejection is respectfully requested.

Claim 10 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Tasumi in view of Kozlowski, Brunner, and in further view of Kozuka et al., U.S. Patent No. 5,557,121 (Kozuka). This rejection is respectfully traversed.

As discussed above, Tasumi, even when considered with Kozlowski, fails to teach or suggest all limitations of independent claim 1. Brunner is cited for its teachings

regarding the composition of layers in an active region of a photodetector, LED, optical modulator or waveguide. Similarly, Kozuka is cited for its teaching regarding the composition of a photosensitive film. Alone or together, Brunner and Kozuka do not supplement the deficiencies of Tasumi and Kozlowski. For at least these reasons, withdrawal of this rejection is respectfully requested.

Claim 14 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Tasumi in view of Kozlowski, and in further view of Nakayama, U.S. Patent No. 5,847,409 (Nakayama). This rejection is respectfully traversed.

As discussed above, Tasumi, even when considered with Kozlowski, fails to teach or suggest all limitations of independent claim 1. Nakayama is cited for its teachings regarding a graded buffer layer and does not supplement the deficiencies of Tasumi and Kozlowski. For at least these reasons, withdrawal of this rejection is respectfully requested.

Claims 15-18 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Tasumi in view of Kozlowski, and in further view of Lee, U.S. Patent No. 6,762,401 (Lee). This rejection is respectfully traversed.

As discussed above, Tasumi, even when considered with Kozlowski, fails to teach or suggest all limitations of independent claim 1. Lee is cited for teaching a reset transistor and does not supplement the deficiencies of Tasumi and Kozlowski. For at least these reasons, withdrawal of this rejection is respectfully requested.

Claims 20-24 and 27-30 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Tasumi in view of Lee, and in further view of Sugawa. This rejection is respectfully traversed.

Independent claim 20 recites an "image sensor" comprising, *inter alia*, "an array of pixel cells at a surface of a substrate, wherein at least one of the pixel cells comprises a

photodiode, the photodiode comprising a plurality of layers, wherein at least a first layer comprises a first material and at least a second layer comprises a second material, wherein the layers are configured such that a difference between the conduction band energies of the first and at least second materials and a difference between the valence band energies of the first and at least second materials promotes ionization by a first carrier type and suppresses ionization by a second carrier type" and "a gate adjacent to the photodiode for transferring the amplified charge from the photodiode."

Lee relates to a CMOS image sensor. Lee teaches that the image sensor includes a plurality of pixels arrayed in columns and rows. Lee's pixels include a photodiode, a reset transistor, a floating diffusion region and a transfer transistor. Lee at Abstract.

The Examiner states that Tasumi differs from the invention as claimed in independent claim 20 because Tasumi fails to teach or suggest an array of pixel cells. Lee, however, teaches an array of pixel cells. The Examiner, therefore, states that it would be obvious to combine the teachings of Tasumi and Lee to achieve the claimed invention. Office Action at 10. Applicant respectfully submits that one of ordinary skill in the art would not have been motivated to combine the teachings of Tasumi and Lee as suggested by the Examiner.

Tasumi relates to a photosensitive element for optical communication in an OEIC structure. Tasumi at col. 1, lines 6-8. According to Tasumi, a photosensing portion 2 is buried and an optical fiber is fixed at the same height as the photosensing portion to introduce light in parallel along the surface. Tasumi at col. 4, lines 1-6. Thus, as Tasumi is unrelated to imaging, one of ordinary skill in the art would not have been motivated to "incorporate the teaching of Lee into the device taught by Tasumi in order to provide highly accurate imaging of the device," as suggested by the Examiner. Office Action at 10. Further, those of ordinary skill in the art would readily understand that Lee's unit pixels are for receiving light from angles not parallel to the surfaces of photodiodes. Accordingly, Lee's unit pixels function differently than Tasumi's optical communication device.

Sugawa is cited for teaching that multiplication layers are configured to promote ionization by a first carrier type and suppress ionization by a second carrier type. Sugawa, however, does not provide any teaching, suggestion or motivation for combining Tasumi and Lee as suggested by the Examiner. For at least these reasons, withdrawal of this rejection is respectfully requested.

Claim 25 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Tasumi in view of Lee, Sugawa, and Brunner. This rejection is respectfully traversed.

Brunner is cited for its teachings regarding the composition of layers in an active region of a photodetector, LED, optical modulator or waveguide. Like Sugawa, Brunner does not provide any teaching, suggestion or motivation for combining Tasumi and Lee as suggested by the Examiner. For at least these reasons, withdrawal of this rejection is respectfully requested.

Claim 26 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Tasumi in view of Lee, Sugawa, Brunner, and Kozuka. This rejection is respectfully traversed.

Kozuka is cited for its teaching regarding the composition of a photosensitive film. Brunner is cited for its teachings regarding the composition of layers in an active region of a photodetector, LED, optical modulator or waveguide. Like Sugawa, however, neither Brunner nor Kozuka provide any teaching, suggestion or motivation for combining Tasumi and Lee as suggested by the Examiner. For at least these reasons, withdrawal of this rejection is respectfully requested.

Claim 31 stands rejected under 35 U.S.C. § 103(a) as being unpatentable over Tasumi in view of Lee, Sugawa, and Lin et al, U.S. Patent Application Publication No. 2003/0218678 (Lin). This rejection is respectfully traversed.

Lin is cited for teaching a pixel array surrounded by a peripheral circuit. Like Sugawa, however, Lin fails to provide any teaching, suggestion or motivation for combining Tasumi and Lee as suggested by the Examiner. For at least these reasons, withdrawal of this rejection is respectfully requested.

Claims 32-34 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Tasumi in view of Lee, and in further view of Brunner. This rejection is respectfully traversed.

Claim 32 recites an "image sensor" comprising "an array of pixel cells, wherein at least one of the pixel cells comprises a photodiode, the photodiode comprising alternating layers of Si and Si_xGe_{1-x}" and "a gate adjacent to the photodiode for transferring the amplified charge from the photodiode."

The Examiner relies on the same reasoning regarding the combination of Tasumi and Lee as in the rejection of claims 20-24 and 27-30. Accordingly, Applicant incorporates the remarks made above in connection with the rejection of claims 20-24 and 27-30. Brunner is cited for its teachings regarding the composition of layers in an active region of a photodetector, LED, optical modulator or waveguide. However, Brunner does not provide any teaching suggestion or motivation for combining Tasumi and Lee as suggested by the Examiner. For at least these reasons, withdrawal of this rejection is respectfully requested.

Claims 35-37 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Lee and in view of Brunner, Sugawa, and He et al, U.S. Patent No. 6,462,365 (He). This rejection is respectfully traversed.

Claim 35 recites a "processor system" comprising, *inter alia*, "an image sensor coupled to the processor, the image sensor comprising: an array of pixel cells, at least one of the pixel cells comprising . . . a photodiode, the photodiode comprising layers of a first

material and at least a second material in contact with one another, wherein the first and second materials are selected from the group consisting of Si, Si_xGe_{1-x}, $Si_xGe_{1-x}C_y$, GaAs, GaAlAs, InP, InGaAs, or InGaAsP, wherein the layers are configured to promote ionization by a first carrier type and suppress ionization by a second carrier type; a gate of a transistor adjacent to the photodiode; a floating diffusion region electrically connected to the first transistor; and readout circuitry electrically connected to the floating diffusion region."

Lee relates to a CMOS image sensor. Lee teaches that the image sensor includes a plurality of pixels arrayed in columns and rows. Lee's pixels include a photodiode, a reset transistor, a floating diffusion region and a transfer transistor. Lee at Abstract. The Examiner notes that Lee fails to teach or suggest a "photodiode comprising layers of a first material and at least a second material in contact with one another, wherein the first and second materials are selected from the group consisting of Si, Si_xGe_{1-x}, $Si_xGe_{1-x}C_y$, GaAs, GaAlAs, InP, InGaAs, or InGaAsP, wherein the layers are configured to promote ionization by a first carrier type and suppress ionization by a second carrier type," as recited by independent claim 35. Office Action at 18.

In Contrast to Lee, Brunner relates to a component for a photodetector, LED, optical modulator or waveguide. Brunner's component includes a silicon substrate, an active region and a silicon capping layer. Brunner at Abstract. Brunner is silent about its component being applicable to a CMOS image sensor, such as that described by Lee. In addition to the multilayer structure, Brunner's component includes first and second contacts to top and bottom layers of the structure in the case of a photodetector. Similar to Tasumi, Brunner teaches an optical fiber fixed at the same height as component to introduce light in parallel with surfaces of the layers of the active region. Brunner at col. 9, line 56 to col. 10, line 9. Those of ordinary skill in the art would readily understand that Lee's unit pixels are for receiving light from angles not parallel to the surfaces of photodiodes. Accordingly, Lee's unit pixels function differently than Brunner's

component. While Brunner relates to photodetection, Brunner is silent about an image sensor. Thus, one of ordinary skill in the art would not have been motivated to incorporate the teaching of Brunner into the device taught by Lee to achieve the claimed invention, or "to provide highly sensitive to a longer wavelength of the device," as suggested by the Examiner. Office Action at 18.

He is cited for teaching an image sensor coupled to a processor. However, He fails to provide any teaching, suggestion or motivation for combining Lee and Brunner as suggested by the Examiner. Sugawa is cited for teaching that multiplication layers are configured to promote ionization by a first carrier type and suppress ionization by a second carrier type. Like He, Sugawa does not provide any teaching, suggestion or motivation for combining Lee and Brunner as suggested by the Examiner. For at least these reasons, withdrawal of this rejection is respectfully requested.

In view of the above amendment, applicant believes the pending application is in condition for allowance.

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Respectfully submitted,

By _____

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